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(71) Applicant
Kerry Ultrasonics Limited
(United Kingdom),
Wilbury Way, Hitchin,
Hertfordshire SG4 0TQ
(72) Inventor
Michael Scott Jeffrey
(74) Agent and/or Address for
Service
G. R. M. Lunt,
Burmah Oil Trading Ltd.,
Castrol Research
Laboratories, Whitchurch
Hill, Pangbourne,
Reading, Berkshire
RG8 7QR

(54) Capacitor discharge welding apparatus

(57) Capacitor discharge welding apparatus head 10 includes an axially slidable piston 20 connected to a sleeve 41 which has a conical shoulder 60 and which is split along part of its length such that, when drawn into a rigid sleeve 56 the sleeve 41 is compressed radially inwardly to grip a stud 44 to be welded. When welding is completed the pneumatically operated piston 20 pushes sleeve 41 out of engagement with sleeve 56 thereby releasing the stud before the head 10 is withdrawn and before a new stud is positioned in the head. Thus wear on the sleeve is minimised and in any event this is taken up by increased movement of the piston 20. This arrangement assists precise location of the stud and helps prevent arcing betweeen stud and sleeve.

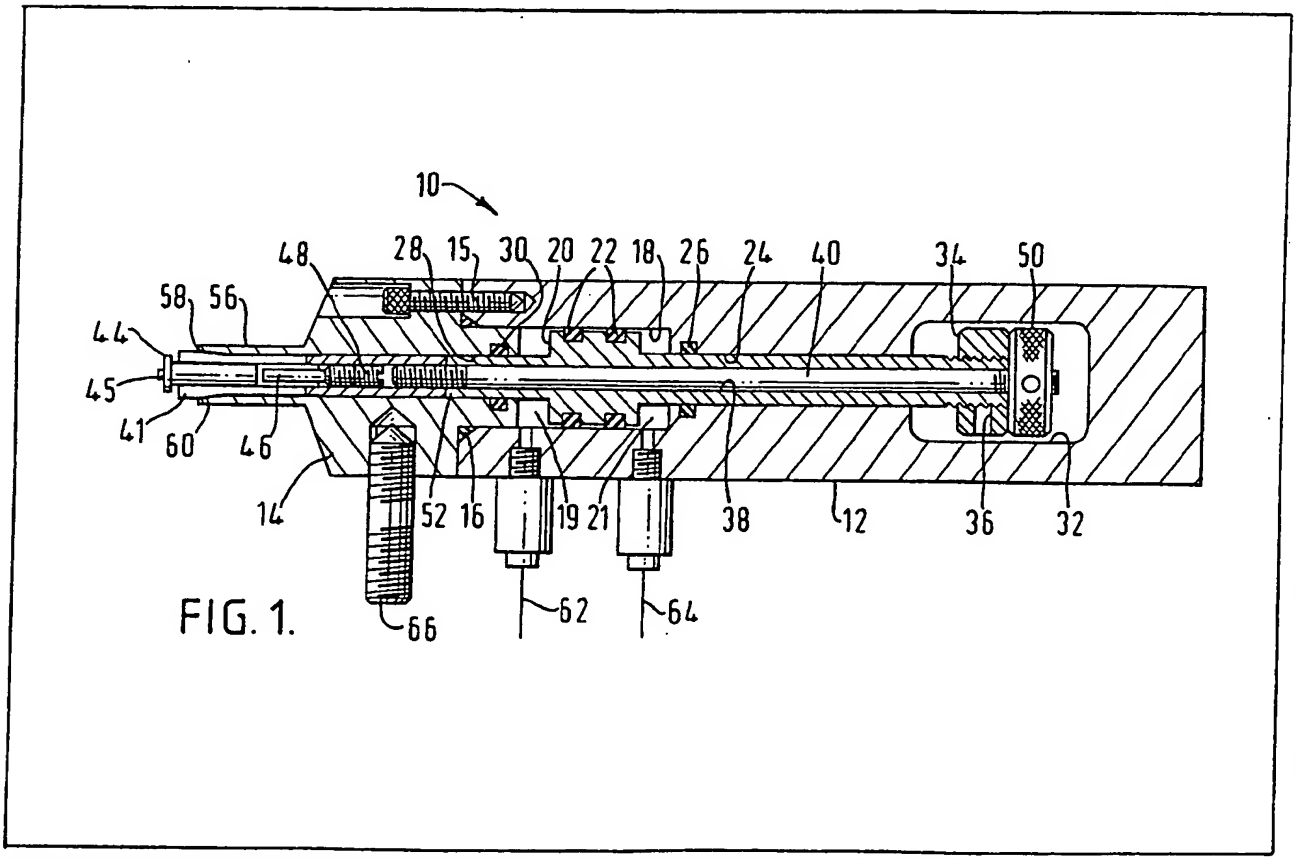

FIG. 1.

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The drawing originally filed was informal and the print here reproduced is taken from a later filed formal copy.

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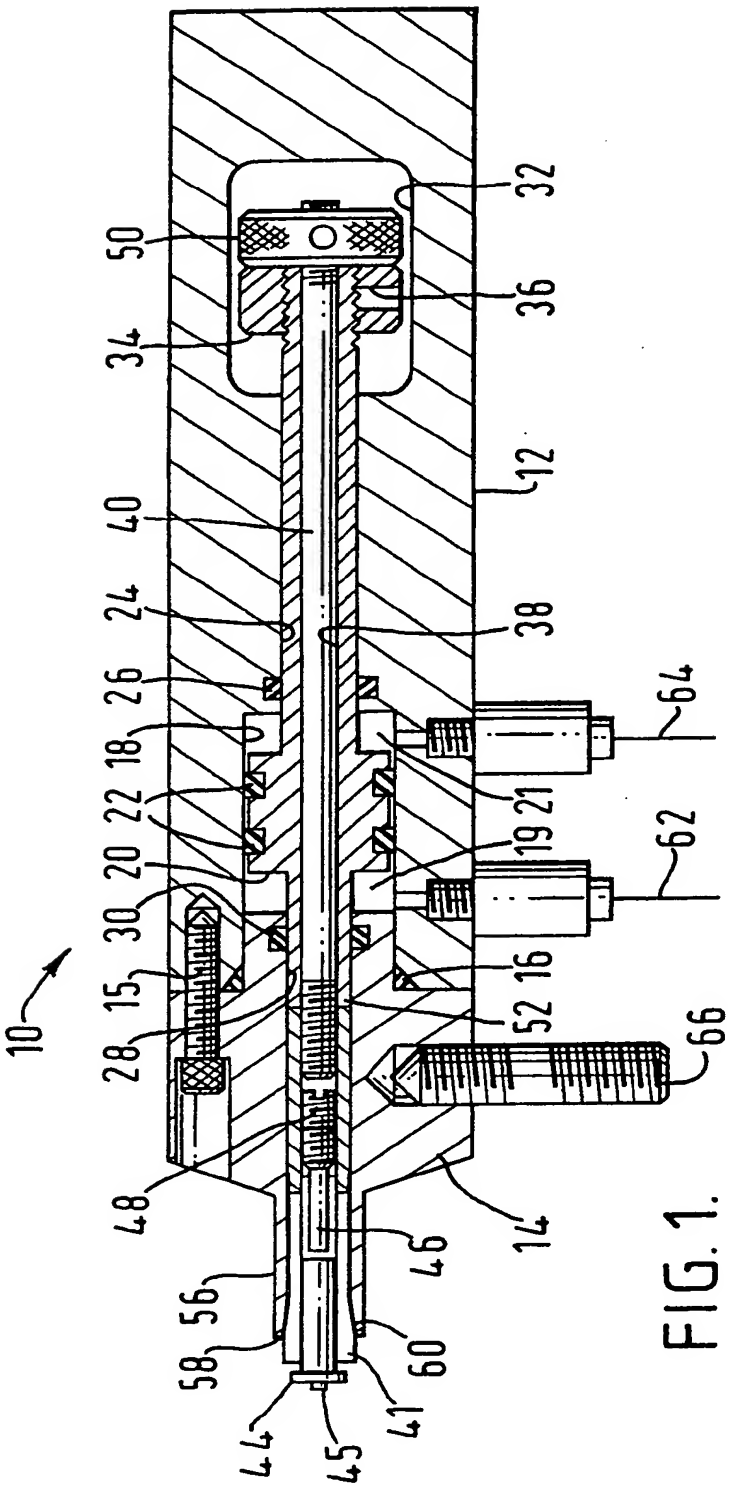

FIG. 1.

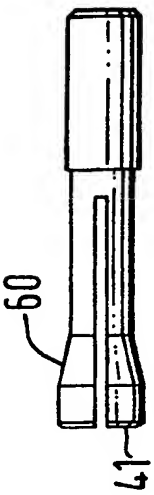

FIG. 2b.

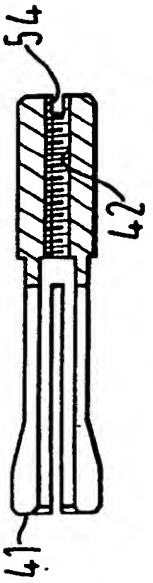

FIG. 2a.

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SPECIFICATION

Capacitor discharge welding apparatus

This invention relates to capacitor discharge stud welding apparatus.

A stud to be welded to a metal base is clamped in a gun forming part of the welding apparatus. When the stud is offered up to the metal base and a pip formed on the end of the stud touches the base an electrical circuit is completed whereby a high power capacitor is discharged through the stud. As a result the pip and a very localised area of the base is heated, melted and fused together thus forming a weld therebetween.

Such a technique offers a number of advantages in that:— no separate source of metal to effect the weld is required; heating is kept to a minimum and restricted to a very localised area around the weld such that, even where the metal base is thin sheet-steel there is little or no marking of the sheet on its opposite side; and little or no skill is required to effect the weld which can nevertheless be accurately positioned.

In one arrangement the stud is held in the gun by a sleeve which is split in several planes along part of its length and which has, near the split, end a circumferential groove carrying a resiliently flexible O-ring which radially inwardly squeezes the split ends of the sleeve together.

A stud to be welded is pressed into the sleeve forcing apart the split ends which thus grip the stud. Once welding has been effected the gun is simply drawn off the stud.

This suffers a number of disadvantages.

For instance, loading of a stud is not easy because the gripping force on the stud has to be overcome. In so doing however the sleeve is progressively worn. Moreover, when the gun and sleeve is dragged over the stud after welding wear again takes place in the sleeve.

With prolonged use the wear in the sleeve may prevent a proper grip being placed on the stud leading to possible arcing between sleeve and stud, lack of concentricity between the two and even a total lack of grip on the stud if the latter should be thin, even within its design tolerances.

Moreover the natural resilience of the sleeve and/or O-ring deteriorates with continuous flexing.

It is an object of this invention to overcome these disadvantages or at least reduce their severity.

In accordance with the invention there is provided a capacitor discharge stud welding apparatus including a gun having gripping means to grip a stud and a capacitor arranged to discharge through the stud into a workpiece to effect a weld therebetween, said gripping means comprising a first sleeve which as an inclined shoulder adjacent one end and a second sleeve surrounding said first sleeve and into which said first sleeve is adapted to be drawn engaging said shoulder with the mouth of said second sle ve to radially inwardly compress said first sleeve at said one end to grip a stud positionable therein. Preferably said first sleeve is split at one end along part of its length in one or more planes.

Wear in said first sleeve is accommodated simply by drawing said first sleeve further into said second sleeve. However, the wear can be minimised by arranging for said first sleeve to be withdrawn from said second sleeve to release a stud gripped therein after the weld has been effected and before the gun is withdrawn from the workpiece.

Preferably drawing and withdrawing of the first sleeve into and out of the second sleeve is effected by means other than by spring means. In this way the effect of deterioration of spring materials can be avoided. Preferably said drawing and withdrawing means comprises a pneumatically operated piston connected via a draw bar to said first sleeve.

The invention is further described hereinafter by way of example with reference to the accompanying drawings in which:—

Fig. 1 is a section through the gun of a capacitor discharge stud welding apparatus according to the invention.

Fig. 2a is a section through said first sleeve of the apparatus showing in Fig. 1; and

Fig. 2b is a side view of said first sleeve shown in Fig. 2a.

A capacitor discharge welding gun or head 10 comprises a body 12 whose open end is closed by cap 14 and sealed by O-ring 16. The cap 14 is secured to the body 12 by one or more suitably disposed cap head screws 15. The body 12 and cap 14 define a cylinder 10 in which is disposed an axially slidable piston 20 which is sealed to the walls of cylinder 18 by O-rings 22.

The piston 20 extends into a bore 24 in the body 12 and is sealed thereto by O-ring 26. The piston also extends into a bore 28 defined in the cap 15 and is sealed thereto by another O-ring 30. Thus two annular pressure chambers 19, 21 are defined by the piston 20 and cylinder 18.

The piston 20 extending through the body 12 terminates in a chamber 32 formed in the body 12 and is screw threaded in this region to accept a knurled thumb screw or nut 34 having drillings 36 into which a tool may be fitted for the purpose of tightening the screw 34. A grub screw (not shown) may be arranged in one drilling 36 to lock the thumb screw 34 on the piston end if desired.

The piston 29 has a centrally extending bore 38 into which a draw bar 40 is fitted from the cap 14 end of the body 12. The draw bar 40 is threaded at both ends.

At one end the draw bar 40 is screwed into the threaded bore 42 of a first sleeve 41 which is shown in greater detail in Figs. 2*a* and 2*b*. The sleeve 41 is adapted in use to grip a stud 44 in the head 10 and for this purpose it is split in two mutually perpendicular planes adjacent one end. To limit the penetration of the stud into the sleeve 41 a stop 46 is screwed into bore 42, followed by a locking grub screw 48, before the draw bar 40 is itself screwed in.

When thus connected, the draw bar 40/sleeve 41 assembly is inserted into the bore 38 in th

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piston 20 until the other thr aded end of the draw bar 40 exits the bore 38. Then a second knurled thumbscrew 50 is screwed onto the bar 40 which is thus drawn further into piston bore 38.

In bore 28 the piston 20 terminates in one or more dogs 52 which are adapted to engage corresponding slots 54 (see Fig. 2*a*) in the sleeve 41. When these are interlocked the knurled nut 50 can be tightened and locked with knurled nut 34.

The end cap 14 is formed with a second sleeve 56 whose bore is outwardly coned at its mouth 58. The sleeve 41 has a coned shoulder 60 and hence when the piston 20/draw bar 40/sleeve 41 assembly is drawn into the body 12 the shoulder 60 on sleeve 41 abuts the coned mouth 58 of the sleeve 56 which thus compresses the split end of the sleeve 41 radially inwardly to grip the stud 44.

In the present embodiment this is effected pneumatically in that pressure lines 62, 64 connect with the pressure chambers 19, 21 respectively.

Thus when pressure is applied to chamber 19 via line 62 and vacated from chamber 21 via line 64 the piston 20 is urged to the right in Fig. 1, thereby drawing the sleeve 41 into the second sleeve 56 to grip the stud 44. Conversely, when pressure is applied to chamber 21 and vacated from chamber 19 the piston 20 moves in the opposite direction to release the stud 44.

An electrical connector 66 is attached to the cap 14 whereby the capacitor discharge current, supplied by means known to those skilled in the art and hence not further explained herein, is passed to the gun or head 10.

Thus to effect a welding operation, pneumatic pressure is first applied to chamber 21 via line 64 to release sleeve 41, from sleeve 56. A stud 44 can thus easily be inserted into the sleeve 41.

Pneumatic pressure is then applied to chamber 19 via line 62 to clamp the stud 44 in the sleeve 41. The head 10 is offered up to an earthed metal base and when the pip 45 on the stud 44 contacts the base a capacitor (not shown) discharges via connector 66, cap 14, sleeve 56, sleeve 41, stud 44 and pip 45 to the base (not shown) and thus to earth.

Th heat generated at the pip 45 by the passage of the current is sufficient to melt the pip 45 and an adjacent region of the base to form a weld therebetween. Before withdrawing the head 10 from the base and stud 44 pneumatic pressure is once again applied to line 64 to release the stud 44 in sleeve 41.

Effective clamping of the stud 44 is achieved without any spring means which may deteriorate in time.

Any w ar in the sle ves 41 or 56 is automatically accommodated by increased movement of the piston 20 as is any variation in the diameter of the stud 44. Wear is in any event minimised because the sleeve 41 is released from its gripping position in the sleeve 56 before the stud is placed in or withdrawn from the sleeve 41.

Furthermore, with such positive locking of the stud in the sleeve 41 and of the latter in the sleeve 56 the concentricity of the stud 44 in the head 10 is always achieved and hence the accuracy of the weld is maintained. Moreover the possibility of arcing between the two sleeves 41, 56 or between the sleeve 41 and stud 44 is significantly reduced.

While pneumatic operation is illustrated it will be appreciated that other means could be incorporated to move the piston 20. For instance either one of the lines 62, 64 could be dispensed with and a relatively large spring, unlikely to wear significantly in the life of the head 10, could be placed in the cylinder 18 on the appropriate side of the piston 20.

Alternative electromagnetic means could be adopted to move the piston 20 in a fashion well known to those skilled in the art.

Nevertheless we find the embodiment illustrated to be convenient for a number of reasons including the fact that apparatus of this type is often provided with pneumatic means for manouvering the head to effect welding and hence can readily be employed as described herein.

Our arrangement of the sleeve 41/draw bar 40/piston 20 assembly is such that the sleeve 41 can be removed for adjustment of the stop 46 or entire replacement of the sleeve without disturbing the sealing arrangements around pressure chambers 19, 21.

CLAIMS

1. Capacitor discharge stud welding apparatus including a gun having gripping means to grip a stud and a capacitor arranged to discharge through the stud into a workpiece to effect a weld therebetween, said gripping means comprising a first sleeve which has an inclined upstanding shoulder adjacent one end and a second sleeve surrounding said first sleeve and into which said first sleeve is adapted to be drawn engaging said shoulder with the mouth of said second sleeve to radially inwardly compress said first sleeve at said one end to grip a stud positionable therein.

2. Apparatus according to claim 1 in which said first sleeve is split at one end along part of its length.

3. Apparatus according to claim 2 in which said sleeve is split in two substantially perpendicular planes.

4. Apparatus according to any preceding claim in which the mouth of said second sleeve is inclined in correspondence with the shoulder on said first sleeve.

5. Apparatus according to claim 5 in which said shoulder and/or said mouth is inclined substantially at an angle of 30° to the axis of said sleev s.

6. Apparatus according to any preceding claim in which said first sleeve is drawn into and out of said second sleeve by a piston disposed in a cylinder and defining at least one pressure chamber pressurisable with pressure medium to slide the piston in the cylinder.

7. Apparatus according to claim 6 in which the

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piston has an extension passing out of the or each pressure chamber and in which said first sleeve is connected to the piston by a draw bar which is disposed in a continuous bore through the piston and the or each extension and which is clamped to the piston outside the or each pressure chamber.

8. Apparatus according to claim 7 in which the piston and cylinder define two of said pressure chambers one of each side of the piston and in which the piston has two of said extensions coaxially disposed one on each side of the piston.

9. Apparatus according to claim 6, 7 or 8 in which said first sleeve is prevented from rotating with respect to the piston by way of a dog on one of the sleeve or piston interengaging with a slot in the other, said first sleeve being clamped to the piston by screw means.

10. Apparatus according to claim 10 when dependent on claim 7 in which said screw means comprises said draw bar which is screwed into said first sleeve to clamp said first sleeve to the piston.

11. Apparatus according to any of claims 6 to 10 in which said piston is pneumatically operated.

12. Apparatus according to any preceding claim in which said sleeve is hollow and screw threaded to accept an adjustable and lockable screw threaded stop to limit penetration of the stud into said first sleeve.

13. Apparatus substantially as hereinbefore described with reference to the accompanying drawings.

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